MA 2121 - DIFFERENTIAL EQUATIONS
OBJECTIVES

The general purpose of this course is to provide an understanding of ordinary di®erential equations (ODE's), and to give methods for solving them. Because di®erential equations express relationships between changing quantities, this material is applicable to many ¯elds, and is essential for students of engineering or physical sciences.

Upon completion of this course, the student should be able to satisfy the following objectives.

A. GENERAL

1. Classify a di®erential equation in terms of ordinary/partial, order, linearity.

2. Verify a solution by substitution into the equation.

3. Explain the di®erence between the general solution to a di®erential equation and the unique solution to an initial value problem (IVP).

4. Determine whether a ¯rst- or second-order linear IVP has a unique solution over a given interval.

5. Apply initial conditions to a general solution to ¯nd the unique solution.

B. FIRST-ORDER EQUATIONS

1. Recognize a linear ODE and solve by an integrating factor.

2. Recognize a separable ODE and solve by separating variables.

3. Recognize an exact equation by checking partial derivatives, and solve by partial integration.

4. Solve appropriate applied problems involving exponential growth/decay or elementary mechanics.

C. SECOND-ORDER LINEAR EQUATIONS

1. Explain the principle of superposition. For a nonhomogeneous IVP, explain the relationships between the homogeneous (complementary) solution, a particular solution, the general solution, and the unique solution.

2. For solutions to a homogeneous equation: De¯ne linear independence. De¯ne the Wronskian, and use it to determine whether two solutions are linearly independent. De¯ne the concept of a fundamental set of solutions, and how it relates to the general solution.

3. Given one solution to a homogeneous ODE, use reduction of order to ¯nd another solution.

4. Find the general solution to a homogeneous ODE with constant coe±cients (whether the roots of the characteristic equation are distinct, repeated, or complex).

5. Explain when the method of undetermined coe±cients is appropriate for ¯nding a particular solution to a nonhomogeneous ODE. Apply this method.

6. Apply variation of parameters to ¯nd a particular solution.

7. Solve appropriate applied problems for mechanical or electronic oscillations. Explain the terms: free oscillations, forcing, damping, resonance, transient and steady response.

8. Find the general solution to a simple linear HIGHER-ORDER ODE with constant coef-¯cients.

D. SERIES SOLUTIONS

1. Given a second-order ODE, determine whether a given point is an ordinary point, a regular singular point, or an irregular singular point.

2. For an ordinary point, ¯nd the ¯rst several terms in each of two linearly independent series solutions. Determine the minimum radius of convergence of these series from the coe±cients of the ODE.

3. Recognize an Euler ODE and ¯nd the general solution.

E. LAPLACE TRANSFORMS

1. State the de¯nition of the Laplace Transform, and use the de¯nition to calculate the transform of a simple function. Given a function, determine whether the transform exists.

2. Use tables and general properties (linearity, derivative, translation) of Laplace Transforms to ¯nd the transform of a given function, or to ¯nd the inverse transform.

3. Use Laplace Transforms to solve a nonhomogeneous second-order IVP, where the forcing function could be discontinuous (express it in terms of unit step functions), or periodic, or involve impulse functions.

4. De¯ne the convolution of two functions, and calculate it, given two functions. Use the convolution theorem to ¯nd the inverse transform of the product of two known transforms.

F. SYSTEMS OF EQUATIONS

1. Write a system of ¯rst-order linear ODE's in matrix form.

2. Find the general solution to a system of homogeneous ¯rst-order ODE's with constant coe±cients (whether the eigenvalues are distinct, repeated, or complex).

3. Use variation of parameters to ¯nd a particular solution to a nonhomogeneous ¯rst-order system with constant coe±cients. Find the general solution.

4. In relation to systems of ODE's, explain the terms: solution vector, linear independence, eigenvalues/eigenvectors, fundamental matrix.

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